AFRL-RX-TY-TP-2009-4568

DEPLOYED BASE SOLAR POWER
(BRIEFING SLIDES)

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14. ABSTRACT

The AFRL/RXQD Energy program demonstrates current technologies in solar power generation and the integration of these technologies onto deployed base structures. This presentation is to describe those efforts along with the capabilities and competencies that have come as a result of this program.

15. SUBJECT TERMS

solar power, photovoltaics, Renewable Energy Tent City, deployed shelter

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Deployed Base Solar Power

Energy Research

The Airbase Technologies Division's Energy Research Group Is Developing Efficient Alternative And Renewable Energy Technologies Including Advanced Solar Concepts For Structures And Power Generators, Wireless Power Transmission, Distributed Fuel Cells, Advanced Heatpump Technology, LED Lighting and Biofuel Technologies to Produce Ground Fuels Onsite

Energy Research Group Overview

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Our Mission Is To

Conduct Exploratory, Advanced, and Applied Research To Develop Next Generation Deployed Energy and Utility Systems To Meet New and Evolving Warfighter Needs

We Are

A Lead In The Air Force Developing The Energy Needs Of The Warfighter And Developing The Next Generation Energy Self Sufficient Airbase

Benefits to the Warfighter

- 82% Reduction in Fuel Consumption
- 25% Reduction in Shelter Cooling Load
- 25% reduction in Electric Generator Deployment.
- Reduce Deployed Footprint While Enhancing Operational Efficiencies And Maintenance Requirements
- Eliminate Noise, Thermal, and Environmental Signatures
- Reduce / Eliminate External Fuel Requirements, Saves Lives Of Soldiers, Marines, Sailors, and Airmen

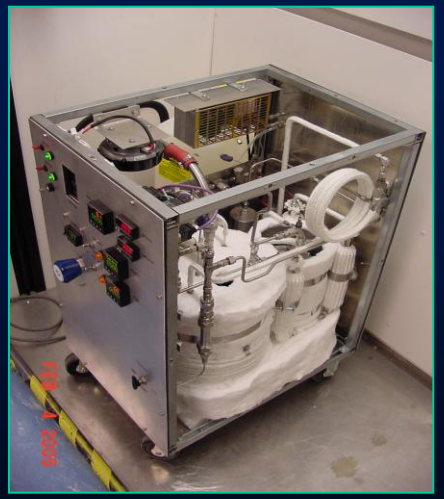
Energy Research Laboratory

Facilities/Equipment

- Capital Value: >$5M
- World Class Capability

One-of-a-Kind 50,000 sq. ft. Renewable Energy Tent City

- Ability to Study Grid Parallel and Autonomous Photovoltaic and Alternative Power Generation Systems in Real World Conditions
- Biofuels Research Facility



25,000 sq. ft. Laboratory Facility

- Fuel Cell/Fuel Reforming Lab
- Fuel Cell Test Center with Multi-fuel Reformer
- Solar Powered DAQ Control Room
- Climate-Control Testing Capability

Future Plans

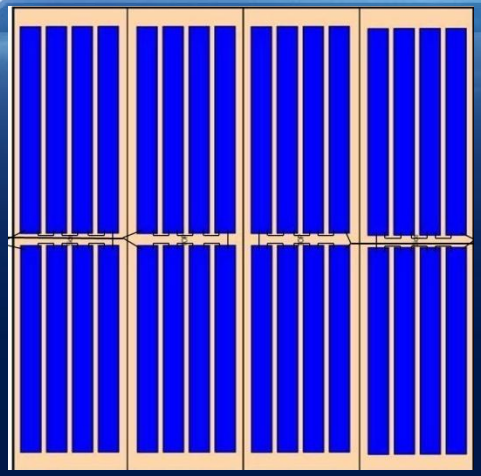
- Expand Experimental Solar Concentrator and Photovoltaic Materials

PV Integrated Shelters

Advantages

- Reduce the Logistics Tail
- Reducing the weight of military operations
- Lower the cost of operations
- Reduce the size and weight of diesel generators
- Reduce systems vulnerability to direct attack

Higher Efficiency = Greater Power



Impact Of Improved PV Efficiency

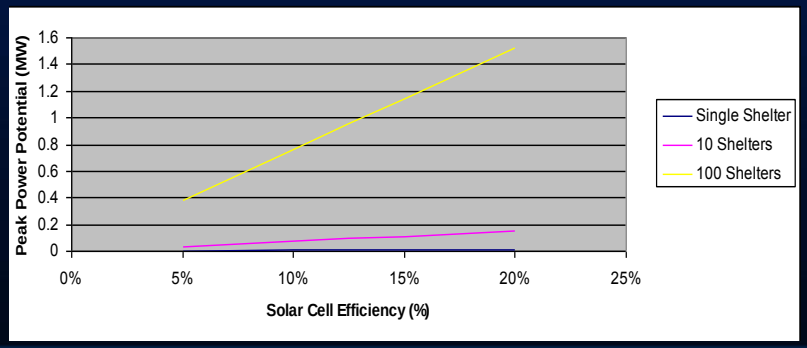
	Single Shelter	10 Shelters	100 Shelters
5%	3.8 kW	38 kW	380 kW
10%	7.6 kW	76 kW	760 kW
15%	11.4 kW	114 kW	1.14 MW
20%	15.2 kW	152 kW	1.52 MW

Solar Cells Characterization

$$ff = \frac{P_{\max}}{I_{sc}V_{oc}} = \frac{I_pV_p}{I_{sc}V_{oc}} \qquad \eta = \frac{P_{\max}}{P_{inc.light}} = \frac{I_{sc}V_{oc}ff}{P_{inc.light}}$$

Standard Test Conditions

- AM 1.5 Illumination 1000 W/m^2
- 25 ° C



PV Technologies of Tomorrow

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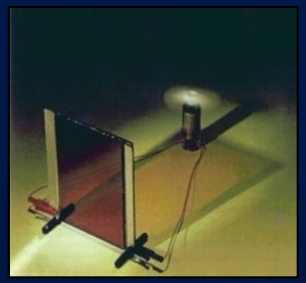
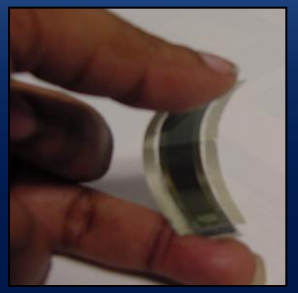
Flexible Thin Film PV with Efficiencies of 15-20% or greater



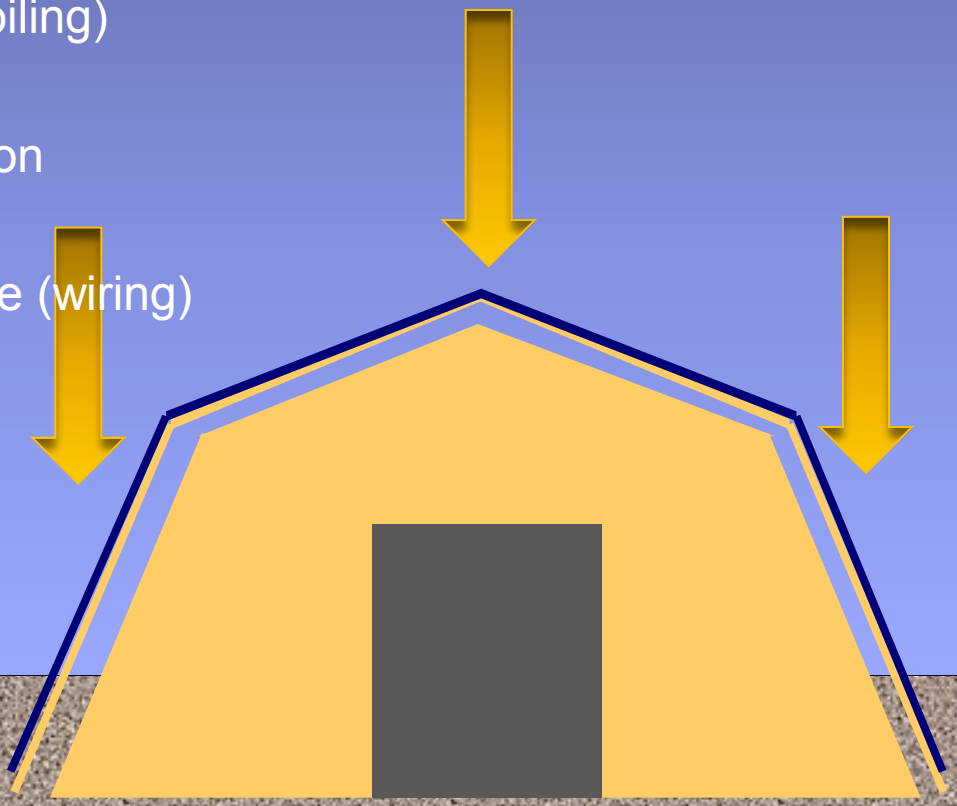
Potential Advantages

- Bifacial Configuration
- Transparency for Power Windows
- Outperforms a-Si
- Compatible with Roll-to-Roll Processing
- Inexpensive



PV Integrated Shelters

- **Loss Factors of PV**
  - Irradiance (clouds)
  - Partial shading
  - Production tolerance
  - Dirt and dust (soiling)
  - Incident angle
  - Shelter orientation
  - Temperature
  - Series resistance (wiring)
  - Inverters (BOS)



Renewable Energy Tent City
Real World Energy Dynamics Study

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Reliability & Durability

- Visual Inspections
- I-V Characteristics

Performance Degradation

- Energy Availability
- Actual Power Generated
- Temperature Vs. Performance

Facility And Utility Demand Reduction

- Reduction/Increase In Thermal Load
- Power Demand

Instrumentation & Data Acquisitions

Data acquisitions systems and components have been installed to obtain the operational data from the systems on a daily basis. The data from these systems are brought in to be analyzed to evaluate performance. Data is recorded at various time intervals.

Data Acquisitions and Components:

- FieldPoint
- Current, Voltage, and Power Transducers
- POA Pyranometers
- Solar Tracking Pyranometer
- Weather Station
- kWh Meter

Parameters being monitored:

- Solar Module Temperatures
- Ambient Temperature
- Wind Speed
- Wind Direction
- Humidity
- Solar Irradiance
- Fuel Cell Generated Power
- PV Amperage & Voltage
- Shelter Loads
- Battery System


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Questions?